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Methyl Bromide Alternatives

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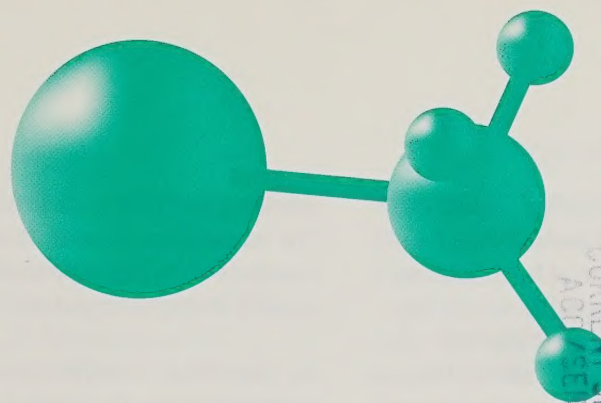
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This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

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Methyl Bromide Recapture System Up and Running

Methyl bromide has been an extremely useful fumigant for disinfecting perishable and durable commodities prior to sale either in the domestic market or to other countries. For years, it was the backbone of the U.S. fight against the introduction of unwanted pests to U.S. shores or exporting unwanted pests to other countries on our commodities. The use of methyl bromide for quarantine and fumigation purposes has been largely responsible for our ability to export commodities to partner nations. It has also formed the basis for lifting export bans against quarantine insects in many countries around the globe. Methyl bromide will be taken off the market for use and production on January 1, 2005, in the United States, as set forth in the Montreal Protocol. However, commodities may be treated with methyl bromide as part of a quarantine or required fumigation of an importing country. It has been estimated that California alone would lose between \$300 and \$400 million in exports if methyl bromide is not available and without viable alternatives.

As a result, in 1995, James Leesch, Research Entomologist in the Agricultural Research Service (ARS) Horticultural Crops Research Laboratory in Fresno, California, began investigating the capture of methyl bromide on

activated carbon, after commodity fumigation. Such an apparatus would greatly reduce the amount of methyl bromide released to the atmosphere. Research began in 1995 in collaboration with Gerhard F. Knapp of GFK Consulting, Ltd. in San Clemente, California, a private cooperator. Great Lakes Chemical Corporation, led by David McAllister, also entered the cooperative research and development agreement in order to transfer the technology into practical uses within the agricultural community. Using such a system, however, is contingent on being able to use methyl bromide. According to the Environmental Protection Agency, uses of methyl bromide for quarantine and preshipment applications are already exempt from control under Article 2H of the Montreal Protocol.

With the exemption allowed, reducing the emission of methyl bromide to the atmosphere was in order. Essentially, after a commodity has been fumigated in a sealed chamber, the air in the chamber is passed through a carbon filter which adsorbs much of the methyl bromide. The carbon filter is sealed and removed to a treatment facility which thermally removes the trapped methyl bromide. "The thermal processing eliminates secondary waste," says Knapp.

Research has identified the most favorable type of carbon for the adsorption of methyl bromide as well as the best conditions for the adsorption. Activated carbon derived from coconut shells has proven to sorb more methyl bromide than carbon derived from either peat or coal. The adsorption of methyl bromide has been found to be inversely proportional to both the temperature and humidity of the gas stream containing the methyl bromide. Typical loading of the carbon with methyl bromide runs from 5 to 10 pounds of carbon for each pound of methyl bromide injected into the commodity fumigation chamber.

Two facilities currently use the methyl bromide recapture system. In the spring of 1999, Great Lakes Chemical Corporation, GFK Consulting, Ltd., and USDA, in a joint venture, installed the new methyl bromide recapture system in place at the Dallas-Fort Worth International Airport (DFW) in Texas. A similar system has been operating at Well-Pict, Inc., in Watsonville, California, since May 2001.

The goal for authorities at DFW was to increase cargo traffic and attract South American import products such as cut flowers. Upon arrival in the United States, commodities infested with quarantine pests must be fumigated with methyl bromide to prevent the entry of unwanted pests. However, local air regulations at DFW prohibit the release of more than 1.1 pound per hour of methyl bromide. The recapture system vastly reduces the amount of methyl bromide released to the atmosphere—95 percent of recoverable methyl bromide is captured by the carbon. “The unit has been in operation for 2 years and is

working well,” says McAllister. “In terms of cost, it adds about one-half cent per pound of commodity being fumigated.”

At Well-Pict, strawberries and raspberries are fumigated before export to the Far East via air freight from San Francisco Bay Area airports. The Well-Pict facility has seven fumigation chambers. An official source test, designed to demonstrate the recapture efficiency of the methyl bromide recapture system, was carried out June 6, 2001. The new recapture system allowed an average of only 0.14 pound of methyl bromide emitted to the atmosphere for every 1 pound of methyl bromide injected into the fumigation chamber. “We estimate this to be an 80 percent reduction from current practice,” says Knapp. “By using the recapture system, the maximum concentration emitted to the atmosphere was reduced from 10,000 parts per million (ppm) methyl bromide to less than 500 ppm.” Testing of the unit took 6 weeks and approval was given by the Monterey Bay Unified Air Pollution Control District (MBUAPCD) and the Santa Cruz County Agricultural Commissioner for full operation in July 2001.

By using the recapture system, the control district is expected to allow Well-Pict to ventilate four fumigation chambers per hour with a corresponding increase in the amount of fruit that can be processed and shipped in any one day. Jerry Steele of the control district is “excited about the possibility. This unit defines the best feasible control technology available.” Steele anticipates final certified approval of the recapture system pending final results from the June source test. According to Steele,

the California Occupational Safety and Health Agency’s permitted exposure limit is 0.025 ppm for 8 hours of voluntary exposure. “This unit, which has a stack concentration of 5 ppm, probably emits less than 0.025 ppm by the time it goes out of the stack and back down to the ground,” explains Steele.

The methyl bromide recapture system is designed to recapture about 95 percent of the methyl bromide that would otherwise be released into the atmosphere after fumigation without interfering with the normal time cycle of the fumigation. At the end of the fumigation exposure time, the atmosphere in the chamber, containing up to 96 ounces of methyl bromide per 1,000 ft³, is removed by the recapture system at a rate of 750 ft³ per minute through a bed of activated carbon. The air stream from the carbon bed contains less than 2 ounces of methyl bromide per 1,000 ft³. The DFW system is designed to ventilate enclosures up to 4,500 ft³ in 30 minutes or less.

David Moeller, Santa Cruz County Agricultural Commissioner, thinks “the recapture system demonstrates a good stewardship of methyl bromide by using the least amount of material most efficiently, thus minimizing the effect on the environment, public, and workers by reducing the amount of exposure.” As the methyl bromide ban becomes reality, it is imperative to reduce the amount of methyl bromide that escapes to the atmosphere. This unit seems to do a more than adequate job.

Critical Use Exemptions: The Time is Now

At the Ninth Meeting of the Parties to the Montreal Protocol held September 25, 1997, in Decision IX/6, the Parties offered a "Critical Use Exemption" from control of methyl bromide uses after the phaseout. For developed countries the exemption will be effective in January 2005; for developing countries, January 2015.

The 2005 methyl bromide phase-out date for developed countries looms large, and focus will now shift towards applying for these critical use exemptions. According to the Montreal Protocol, exemptions from methyl bromide phase-out for critical uses are allowed provided certain conditions are met. Those applying for the critical use exemption must fulfill clause (b)(iii) of Decision IX/6. This clause states that the exemption will only be allowed if "it is demonstrated that an appropriate effort is being made to evaluate, commercialise and secure national regulatory approval of alternatives and substitutes...developed countries must demonstrate that research programmes are in place to develop and deploy alternatives and substitutes..." The Montreal Protocol also stipulates that users applying for a critical use exemption must demonstrate a significant market disruption and a lack of "technically and economically feasible alternatives."

The Montreal Protocol's Technology and Economic Assessment Panel (TEAP) issued a report in April 2001 outlining the status of the critical use exemption process. Since 2005 is only three growing seasons away, it is important for Parties to apply for the exemptions as early as possible.

Details about the domestic review process for the applications are being formulated by the Environmental Protection Agency (EPA) and the U.S. Department of Agriculture (USDA). However, TEAP issued tentative timetables for the application process in its April 2001 report. "A Party may wish to consider submitting to the Ozone Secretariat a nomination for a critical use exemption for 2005 by January 31, 2003, for a decision as early as the 2003 Meeting of the Parties," according to the TEAP report. "A 2003 decision by the Parties would allow farmers 12-15 months to plan agricultural practices for the 2005 growing season. A Party may (still) wish to submit a nomination to the Ozone Secretariat by January 31, 2004, but the applicant would have only 2-3 months notification by the Parties prior to January 1, 2005, on whether or not to grant an exemption for the use of methyl bromide after that date."

Each Party will need time to review applications from growers and other methyl bromide users prior to submitting nominations to the Secretariat. In turn, applicants will need time to prepare the application and gather supporting data.

TEAP developed a draft Critical Use Exemptions application timetable for consideration by the Parties. When decisions are needed 12-15 months prior to the 2005 growing season, TEAP delineated the following:

June 2002: Methyl bromide users apply to national governments

January 2003: National governments submit nominations to the Secretariat

May 2003: TEAP and MBTOC make recommendations to the Parties

July-December 2003: Parties decide (at the 15th Meeting of the Parties)

EPA anticipates requesting applications from U.S. methyl bromide users in early 2002. The U.S. Government will submit its nomination to the Secretariat in January 2003, after which the Protocol's Methyl Bromide Technical Options Committee (MBTOC) will make recommendations to TEAP, which will make recommendations to the Parties in May 2003. The Parties will make decisions on the critical use exemption applications during the 15th Meeting of the Parties which will be held sometime between July and December 2003. Applications submitted to the U.S. Government in 2003 (and submitted to the Secretariat in January 2004) will be decided upon at the 16th Meeting of the Parties in mid to late 2004, limiting planning time for growers applying for a 2005 exemption in 2003. In light of this time line, it is best for U.S. growers to make their applications to EPA in early 2002.

In preparation for critical use exemption applications, EPA held stakeholder meetings on February 16 and March 19, 2001, in Washington, DC. In the Federal Register on June 27, 2001, EPA announced that the agency is planning to "submit an Information Collection Request (ICR) to the Office of Management and Budget (OMB): Request for Applications for Critical Use Exemptions from the Phaseout of Methyl Bromide, ICR #2031.01."

This is the first of three required Federal Register notices. The next notice will state that an ICR has been submitted to OMB and that comments will be accepted. The last notice will state approval of the ICR. The June 27 Federal Register notice states the data collection is designed to “(1) Maintain consistency with the international treaty, the Montreal Protocol on Substances that Deplete the Ozone Layer; (2) ensure that any critical use exemption complies with Section 604(d) of the CAA; and (3) provide EPA with necessary data to evaluate an application for a critical use exemption and to evaluate the technical and economic feasibility of methyl bromide alternatives in the circumstances of the specific use.”

“While the administrative groundwork is being laid, users need to prepare now,” says Amber Moreen, Environmental Scientist, EPA. “Methyl bromide users need to pull together research data on the alternatives tested and elucidate future research plans. Users must show they meet the Montreal Protocol’s critical use exemption criteria.”

The activities being undertaken by USDA, EPA, and TEAP make apparent the realities and importance of critical use exemptions to growers. The time to act is almost upon them.

Technical Report

California Regulatory Impacts on Adoption of Methyl Bromide Alternative Fumigants

Tom Trout, USDA-ARS Water Management Research Laboratory, Fresno, CA

From 1991 to 1999, methyl bromide use in California decreased from 18.5 to 15 million pounds, while use of alternative registered fumigants increased from 7.5 to over 24 million pounds. Telone (1,3-dichloropropene) was reintroduced for use in 1994 and about 3 million pounds was used in 1999, mainly on orchards and vineyards and at reduced rates on annual vegetables (carrot, tomato, and sweetpotato). Chloropicrin use has gradually increased in the last 2 years to about 4 million pounds because it is being used at higher ratios in methyl bromide mixtures as a means of extending the limited methyl bromide supplies. Very little chloropicrin is used as a stand-alone fumigant, although current research shows it has potential as a stand-alone fumigant for some crops. Over 70% of the chloropicrin use is on strawberries. Use of metam sodium, which generates the fumigant methyl isothiocyanate (MITC), has increased dramatically to over 17 million pounds and has now surpassed methyl bromide in use. It is primarily used on annual vegetable crops (carrot, tomato, potato, melons) as a less costly alternative to other fumigants.

These increasing use patterns appear to indicate that current regulations are not precluding use of these currently available alternatives. However, growers and

applicators are quick to provide examples of how current or anticipated regulations will limit their use. This is especially true in California where use conditions in addition to those on the United States Environmental Protection Agency (EPA) label are often imposed. I will summarize the regulatory procedures in California and the impacts of these current and anticipated regulations on use of alternative fumigants.

California Fumigant Regulatory Process

California fumigant use regulations may vary from those in other states in three ways—the California label, State-issued permit conditions, and specific conditions imposed at the county level for individual applications. The California Department of Pesticide Regulation (DPR) may require data in addition to that required by EPA before it will register and allow use of a pesticide. For fumigants, this often includes efficacy data for the material under the proposed use and information on air emissions, transport, and fate. Fumigant registrants may work simultaneously with EPA and DPR so that their registration packages meet both needs. DPR’s current intent is to adopt the national label without changes and to impose any further restrictions they feel are necessary in the form of *Suggested Permit Conditions*. These permit conditions may include restrictions on application rates, buffer zones around fumigated fields, worker conditions, environmental conditions, and total fumigant use in an area.

Suggested Permit Conditions are actually recommendations to county agricultural commissioners who are responsible for authoriz-

ing, regulating, and accounting for all fumigant applications. All pesticide applications in California are required to meet the intent of the California Environmental Quality Act (similar to the federal NEPA) through a notice and permit process with public scrutiny. Thus, all fumigant applications begin with a "Notice Of Intent" filed with the county agriculture commissioner's office. These notices include the field, crop, fumigant, and rate, and the issued Permit will note use conditions and restrictions specific to the fumigant and application. County agriculture commissioners (appointed by the county board of supervisors) must answer to both farmers and concerned citizens (neighbors and other residents concerned about the potential dangers of pesticides). They usually follow DPR issued Suggested Permit Conditions, but may also (and sometimes do) further restrict use. Although county restrictions are on individual applications, they may be printed up as county guidelines. County restrictions may be based as much on nuisance aspects (smell, irritation) and perception as on actual risk. County inspectors ensure that the permit conditions are met.

Regulatory Impacts on Use of Telone

Telone is the only one of the three currently registered fumigants to have completed the EPA re-registration process. It has also completed most of the State's risk characterization process. Telone is also the most restricted of the three currently. Current label restrictions include 300-foot buffers around occupied residences (100 feet for drip application and no buffer if not refumigated for 3 years), 35 gal/acre maximum

application rates (except for nurseries), 5-day field reentry periods, use of full face respirators and chemical resistant hats, gloves, boots, and aprons for workers in the field, and moist soil requirements during application and a soil "seal" following application to reduce emissions.

Each of these restrictions can limit use in some situations. Three hundred foot buffers eliminate fumigation on about 7 acres of surrounding land; 100-foot buffers affect only about an acre. The worker personal protective equipment (PPE) requirements limit the ability to install plastic tarps in warm climates. Thirty-five gallons per acre may not be adequate for deep-rooted tree and vine crops. The soil moisture requirements in most years are difficult and/or expensive for California tree and vine growers to achieve.

California Suggested Permit Conditions imposed 300-foot buffers until this summer when they were reduced to 100 feet to match the new EPA drip-applied Telone (InLine and Telone EC) label. Applications are also restricted in the San Joaquin Valley in December and January when air inversions are common.

The primary restriction in current California Permit Conditions are township caps on Telone applications. Chronic exposure is a concern with Telone, and township caps are designed to limit air concentrations over extended time periods in an area. California township caps limit Telone applications to no more than 9,600 "adjusted" gallons of Telone (90,050 lb 1,3-D) in any 36 square mile (23,040 acre) township. Adjusted pounds are the actual pounds multiplied by an application factor of 1.0 for deep (>18

inch) shank applications and 1.9 for shallow (>12 inch) shank applications. Township caps limit applications to about 1 percent of the land for a typical strawberry or orchard/vineyard fumigation and 2 percent of the land for a typical vegetable fumigation.

As Telone use has increased, township caps have begun to limit applications. In 2000, cap limits were hit in four townships and were nearly hit in nine additional townships. As methyl bromide is phased out and Telone use increases, the caps will be more constraining. An analysis of the impacts of the township caps on potential use (Carpenter et al. 2001, Trout 2001) showed that only about two-thirds of the land presently fumigated with either Telone or methyl bromide would be able to use Telone.

The township cap impacts varied greatly by crop and region, because fumigated crops are concentrated in particular townships. By far the greatest impact is on strawberries. Eighty-five percent of California strawberries are grown in 23 townships and only about one-third of the strawberry land could be fumigated with Telone. Other crops affected by the township cap are crops grown in the same coastal townships as strawberries (flowers, nurseries, vegetables) and other crops grown in concentrated areas such as carrots and sweetpotatoes. Impact on trees and vines would be about 10 percent statewide because these fields are only replanted, and thus fumigated, every 7 to 40 years. Tomato has not traditionally used methyl bromide but is beginning to use Telone over wide areas. Because of the large number of acres involved, the caps will limit this use.

Dow AgroSciences is currently working with DPR to determine if township caps can be raised in some areas. However, because strawberry cropping is so concentrated, doubling the township caps will only raise the portion of the land currently fumigated with Telone or methyl bromide that can use the product from 67 percent to 80 percent, and will raise the portion of strawberries that can be fumigated from one-third to one-half.

Because the Telone label and permit conditions are restrictive, county agriculture commissioners seldom impose further use restrictions.

Dow AgroSciences was issued an EPA and DPR label for their drip-applied emulsified formulations of Telone (Inline and Telone EC) this summer. The current label restricts the crops (strawberries, vegetables, melons) and application methods (drip under plastic (HDPE) mulch). Applicators are not required to wear respirators during application if the delivery system is “closed”. Drip application in California has an application factor for township cap calculations of 1.16. The formulation is not labeled for perennials or ornamentals.

Regulatory Impacts on Use of Chloropicrin

Current chloropicrin labels are not restrictive to use. There are no buffer or crop limitations, allowable rates are high, respirators are not required unless air concentrations exceed 0.1 ppm, and the reentry period is 2 days. Soil surfaces can be sealed with sprinkler irrigation, cultivation, or plastic tarp. One label (TriClor) includes field mixing with an emulsifier for drip application at

up to 300 lb/acre. The TriClor label limits drip application irrigation amounts to 1.5 inches of water, which is inadequate for some applications.

Because chloropicrin use in the past has typically been in combination with methyl bromide, DPR has not issued Suggested Permit Conditions specifically for chloropicrin. However, in anticipation of increased use, some county agriculture commissioners have created local guidelines for chloropicrin permits. For example, Santa Cruz and Monterey counties limit application rates to 200 lb/acre (inadequate for most stand-alone uses), and requires 100-foot buffers for “sensitive sites” (occupied residences nearby). When DPR completes its risk assessment for chloropicrin, there will likely be additional use restrictions.

Regulatory Impacts on Use of Metam Sodium

Current metam sodium labels allow application by spray/incorporation, shank injection, drip, sprinkler, and flood irrigation at rates up to 75 gal/acre. The soil must be moist (between 50 percent and 80 percent of field capacity), and the surface can be sealed by tarps, sprinkler irrigation, or cultivation. Respirators are not required unless odors are strong. Reentry is 2 days.

The Suggested Permit Conditions for metam sodium restrict use near “sensitive sites” when rates exceed 15 gal/acre (most uses). Conditions include 500-foot buffers, hourly field monitoring for odors, and sprinkler systems in place if odors become strong. With sprinkler application, a “water cap” must be applied immediately following application. The DPR issued guidelines point out that county agriculture commissioners

may institute more restrictive conditions, which many do. For example, in Fresno County, the Notice of Intent to fumigate must be filed 96 hours in advance and must map all occupied structures within one-half mile of the site. If the site is in a sensitive or residential area, the buffer is one-half mile for all except shank applications. The Metam Sodium Task Force is currently working with the DPR to develop acceptable Permit Conditions, including buffers, that can be used uniformly by counties. Applications will likely include improved soil sealing and site monitoring.

Future Regulatory Impacts

Fumigants are going through re-registration at the Federal level and reevaluation in California. The state process involves a risk assessment of the compound and then steps to mitigate the risks. Mitigation can take the form of permit conditions or State regulations. California DPR issues a monthly *Status Report for Fumigant Pesticides* where information on the fumigant risk assessment/management process is summarized and updated.

Of the three registered alternatives, only Telone products have completed this re-registration process. Dow AgroSciences is now working with DPR to reassess the analysis that was used to establish the Telone township caps with the goal to increase the caps in some areas. A draft of the risk assessment document for metam sodium is under public review. Metam sodium has been placed on the restricted materials list. The risk assessment for chloropicrin has just begun. As was noted, some county agriculture commissioners are applying permit condition restrictions on these materials.

The State is carrying out ambient air monitoring of fumigants in areas of heavy use. Monitoring in the Watsonville area in 2000 indicated methyl bromide levels exceeded target seasonal (subchronic) exposure levels (1 ppb) in some areas. This nearly triggered emergency regulations on the use of methyl bromide and has resulted in a court-ordered temporary restraining order on methyl bromide applications in specific areas. This summer and fall, ambient air concentrations of methyl bromide, 1,3-D, chloropicrin, and MITC (generated from metam sodium) are being monitored in two regions.

California fumigant users point to methyl bromide regulation as an example of what could happen to other soil fumigants. Restrictions in California on methyl bromide use have increased dramatically in the last 5 years. A recent court decision requires DPR to issue use regulations instead of Suggested Permit Conditions. These regulations include a complex formula to calculate buffers depending on application method and rates. For example, for a 10-acre orchard fumigation, the buffer would be 840 feet if it were fumigated at one time. Multiple applications of portions of the field are often required to reduce buffers to acceptable levels. The new regulation also requires extensive prenotification of occupants of residences within 300 feet of the buffer, and limits in-field workers (drivers, copilots, tarp layers) to no more than 4 hours per day in the field. These restrictions have resulted in both legal and practical limitations where methyl bromide can be used and increased application costs.

Conclusions

Fumigant use regulations are more complex and restrictive in California than in other states. Telone township caps will severely restrict use in some areas. County applied buffers also limit uses. Although current restrictions on alternative fumigants are of concern to growers, of more concern is not knowing what future regulations will be. As long as the rules may change, it is precarious to invest time and money into adopting and adapting to alternative fumigants.

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